

## FT 2100. OXIDATION-REDUCTION POTENTIAL (ORP)

Use in conjunction with:

- FT 1000 General Field Testing and Measurement
- FQ 1000 Field Quality Control Requirements
- FS 1000 General Sampling Procedures
- FD 1000 Documentation Procedures

### 1. INTRODUCTION AND SCOPE

Oxidation Reduction Potential (ORP) is a measurement of the potential for a reaction to occur. These reactions mediate the behavior of many chemical constituents in drinking, process and wastewaters as well as most aquatic environments.

The obtained value is a crude estimate of the oxygen status of a sample. A positive value indicates that the water is in an oxidized state or oxygen is present. A negative value is indicative of an anaerobic type environment or reducing condition.

### 2. EQUIPMENT AND SUPPLIES

2.1. Field Instrument: Millivolt meter or pH meter with millivolt reading capability to  $\pm 1400$  mV.

2.1.1. Redox electrodes: either an inert indicator electrode and reference electrode or combination electrode.

2.1.2. Indicator electrode: the most commonly used is the platinum electrode. A noble metal or graphite electrode can be used for specific applications (refer to SM 2580B for selected sample types).

2.1.3. Reference electrode: consisting of a half-cell providing a constant electrode potential (most commonly used are calomel or silver:silver-chloride electrodes).

2.2. Standards: Purchase or prepare standard redox solutions (refer to SM 2580B for suggested standard solutions and preparation procedures).

2.3. Recordkeeping and Documentation Supplies:

- Field record forms (e.g., forms FD 9000-7, FD 9000-8 and FD 9000-9) or field notebook
- Indelible pens

### 3. CALIBRATION AND USE

3.1. General Concerns: Follow the manufacturer's instructions for using and preparing electrodes.

3.1.1. For specific indicator electrodes, select a standard solution of known redox potential to check the electrode response at the temperature of measurement (refer to section 2.2 above).

3.1.2. Minimize sample contact with the atmosphere by analyzing at time of sample collection.

3.1.3. The temperature of the standard solution, when read, must be at a temperature as close as possible to that of the sample.

### 3.2. Interferences

3.2.1. Contamination of the electrode surface can lead to excess drift, poor electrode response and artifact potentials.

3.2.2. Redox potential is sensitive to pH of the sample.

### 3.3. Calibration

3.3.1. Check electrode response before use, preferably in the field. If the check is performed at the base of operations, the instrument must be rechecked prior to use. Perform quality control checks according to FT 1000, section 2.2.

3.3.2. Use a shorting lead to verify the zero point on the meter's millivolt scale.

3.3.3. Equilibrate the standard solution to the temperature of the sample.

3.3.4. Immerse the electrodes and gently stir the standard solution in a beaker (or flow cell). Turn the meter on, placing the function switch in the millivolt mode.

3.3.5. Let the electrode equilibrate for several minutes and record the reading to the nearest millivolt. The reading must be within  $\pm 10$  mV from the theoretical redox standard value at that temperature. If not, determine the problem and correct it before proceeding. Switch to temperature display and read the value.

3.3.6. Record the mV reading and temperature in the field notebook or in form FD 9000-8.

3.3.7. Rinse the electrode with distilled water and proceed with the sample measurement.

### 3.4. Measuring ORP in Samples

3.4.1. After checking calibration, rinse the electrodes thoroughly with sample water and then immerse them in the gently stirred sample.

3.4.2. Let equilibrate and record the ORP value, to the nearest millivolt, and the sample temperature. Record them in the field notebook or a form designed for this purpose.

3.4.3. Recheck calibration more frequently if turbid, organic-rich or high-dissolved solutions are being measured.

3.4.4. After use, rinse the outside of the electrode with distilled water. Use a liquid non-phosphate detergent solution, if needed, to remove oily residues.

4. PREVENTIVE MAINTENANCE: Refer to FT 1000, section 3.

5. RECORDS: See FT 1000, section 4 for additional details.

5.1. Calibration: Record all calibration information (initial and continuing) in the field notebook or on a form specifically designed for this purpose (e.g. FD 9000-8). This information must be recorded:

5.1.1. The calibration method (or SOP) and the type of standard(s) (including the concentrations) used.

5.1.2. Record each calibration check (initial, continuing or final) in the permanent field records (or calibration logs). At a minimum, these records must include:

- 5.1.2.1. Date, time and location (e.g., monitoring well MW -X; laboratory; etc.) of each calibration check;
  - 5.1.2.2. Individual performing the check;
  - 5.1.2.3. Results of each check, including the concentration/type of standard, expected reading, and the actual reading;
  - 5.1.3. Whether the check met or failed acceptance criteria;
  - 5.1.4. Readings associated with a failed check; and
  - 5.1.5. Corrective actions associated with failed check (such as recalibration, removal from use, etc.).
  - 5.1.6. Optionally, enter the meter name, model number, and identification number (if applicable).
- 5.2. Samples: Record the sample results on the appropriate field parameter sheets (e.g., Form FD 9000-7) or in a field notebook. For each sample record the following information:
- Project Name
  - Date and time the measurement was collected
  - Location of the sample (description, monitor well number, etc.)
  - Analyte Name
  - Reporting Units
  - Sample Value
  - Initials of the person taking the measurements.
- 5.3. Reagent and Standards Documentation: Maintain documentation on calibration standards and other reagents.
- 5.3.1. At a minimum, note the date of receipt, expiration dates (on the bottle label), and date of first use (on the standard container).
  - 5.3.2. Follow expiration dates: If any standard or chemical is used after the expiration date, there must be documentation showing that the reagent is providing an acceptable response.

## **FT 2110. REFERENCES**

1. American Public Health Association, American Water Works Association, Water Pollution Control Federation, SM 2580B, Standard Methods for the Examination of Water and Wastewater, 20<sup>th</sup> Edition, 1999.
2. U.S. Geological Survey, National Field Manual for the Collection of Water-Quality Data: Techniques of Water-Resources Investigations, Book 9, Chapter 6.5 Reduction-Oxidation Potential (Electrode Method), April 1998.
3. U.S. Environmental Protection Agency and U.S. Army Corps of Engineers, U.S. Army Engineer Waterways Experiment Station, Procedures for Handling and Chemical Analysis of Sediment and Water Samples, Technical Report, EPA/CE-81-1, pp. 3-52 to 3-53, 1981.

**Appendix FT 2100**  
**Tables, Figures and Forms**

Form FD 9000-7	Field Parameter Data Sheet for Surface Water
Form FD 9000-8	Field Instrument Calibration Records

SURVEY/PROJECT: \_\_\_\_\_ SAMPLERS: \_\_\_\_\_  
 \_\_\_\_\_ METER # \_\_\_\_\_

[illegible]

FIELD CONDITIONS FOR STATION# _____ AT TIME _____:	
CLOUD COVER (%): _____	WIND DIRECTION: _____
TIDAL STAGE: _____	
PREVIOUS RAINFALL: _____	WIND SPEED (MPH/KNOTS): _____
WAVE CONDITIONS: _____	

**Note: This Sheet is used for recording Sample Data – Calibration information must also be documented (see FT 1100, section 4)**

